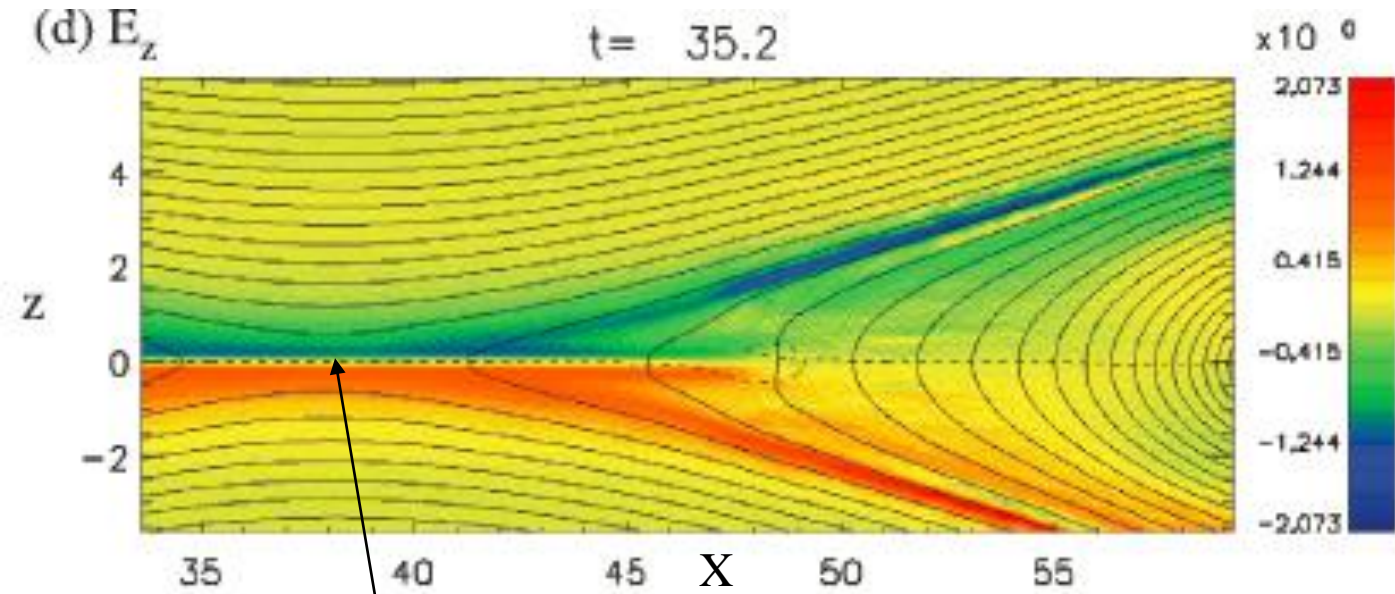


Ion dynamics during magnetotail reconnection

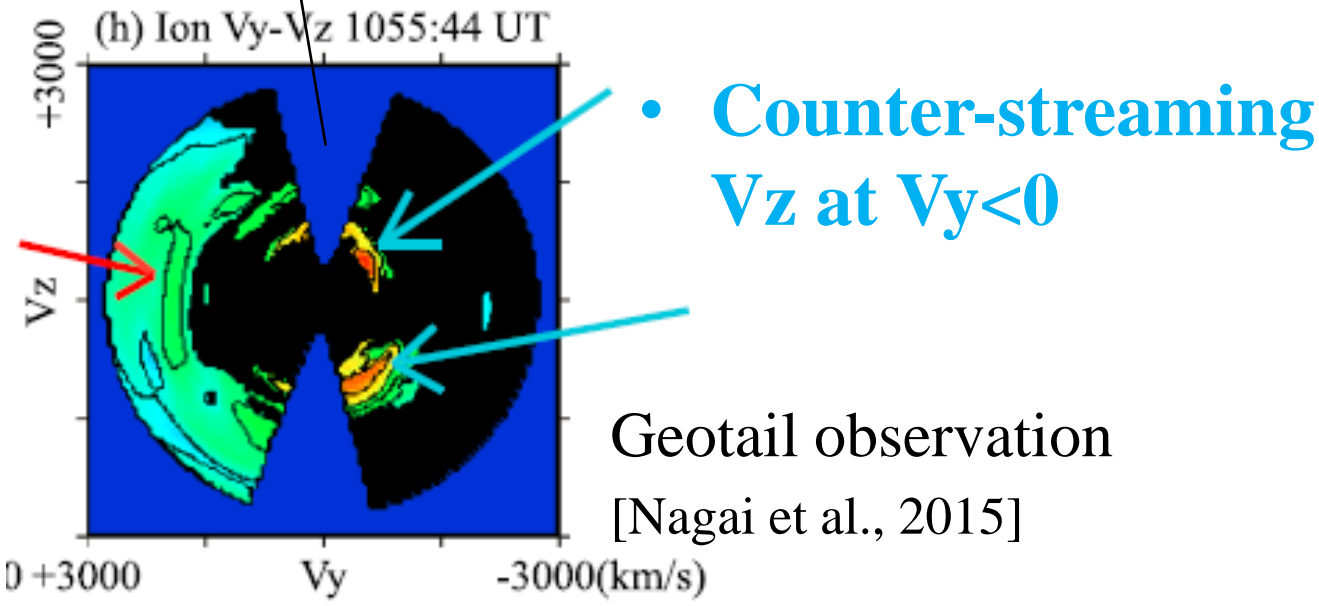
Shan Wang^{1,2}, Li-Jen Chen², Naoki Bessho^{1,2}, Michael Hesse³,
Barbara Giles² and MMS team

1. University of Maryland, College Park
2. NASA Goddard Space Flight Center
3. University of Bergen, Norway

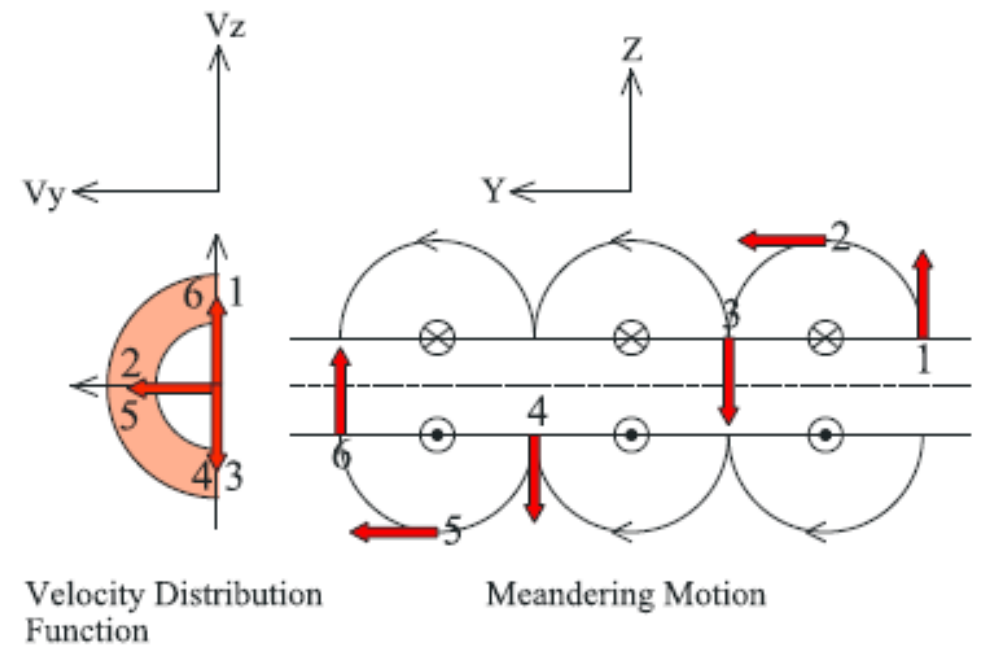
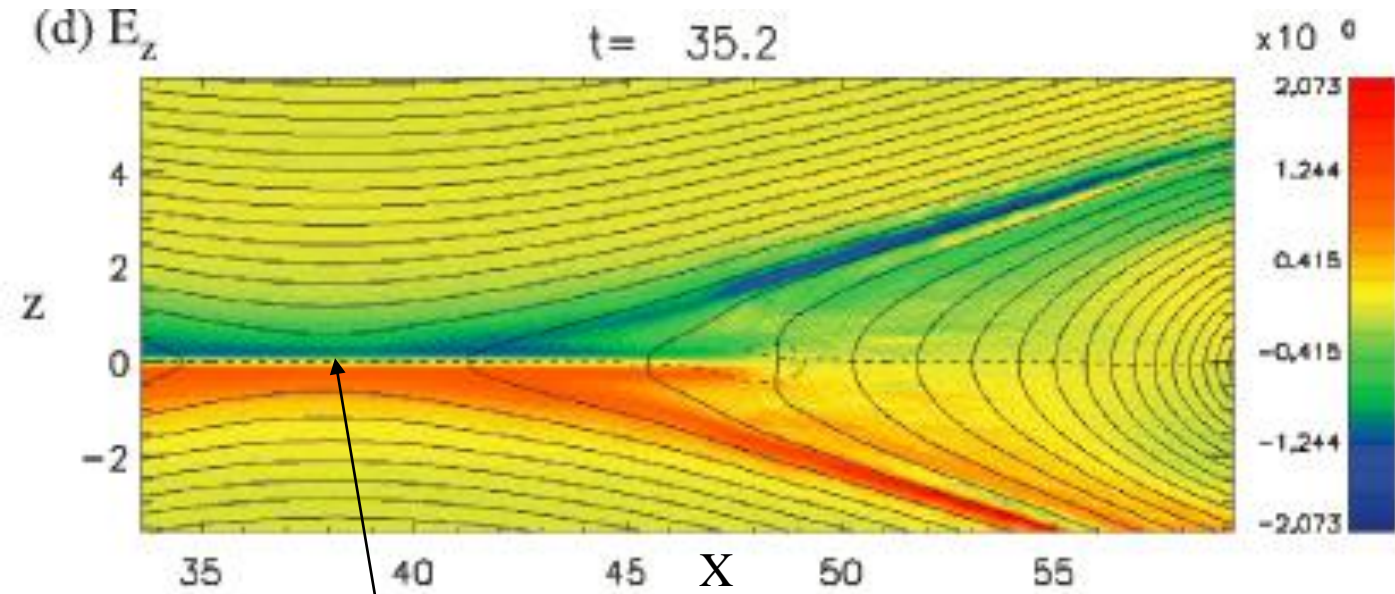
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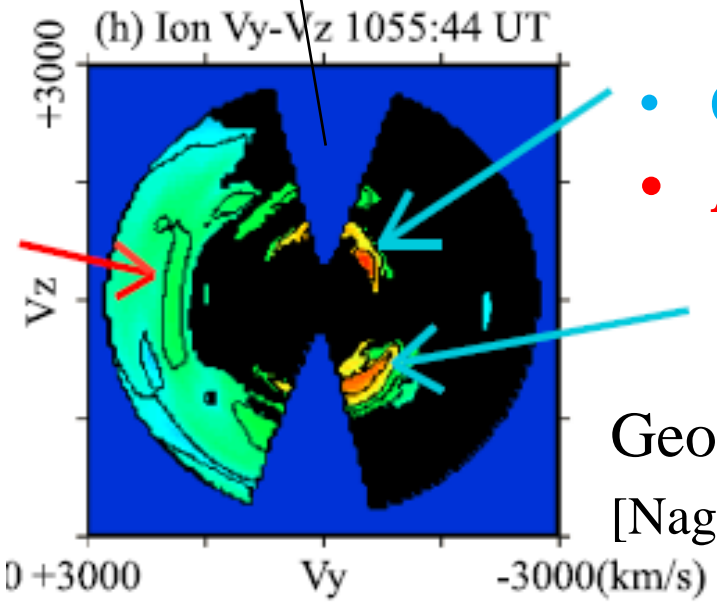
[Zenitani et al., 2013]



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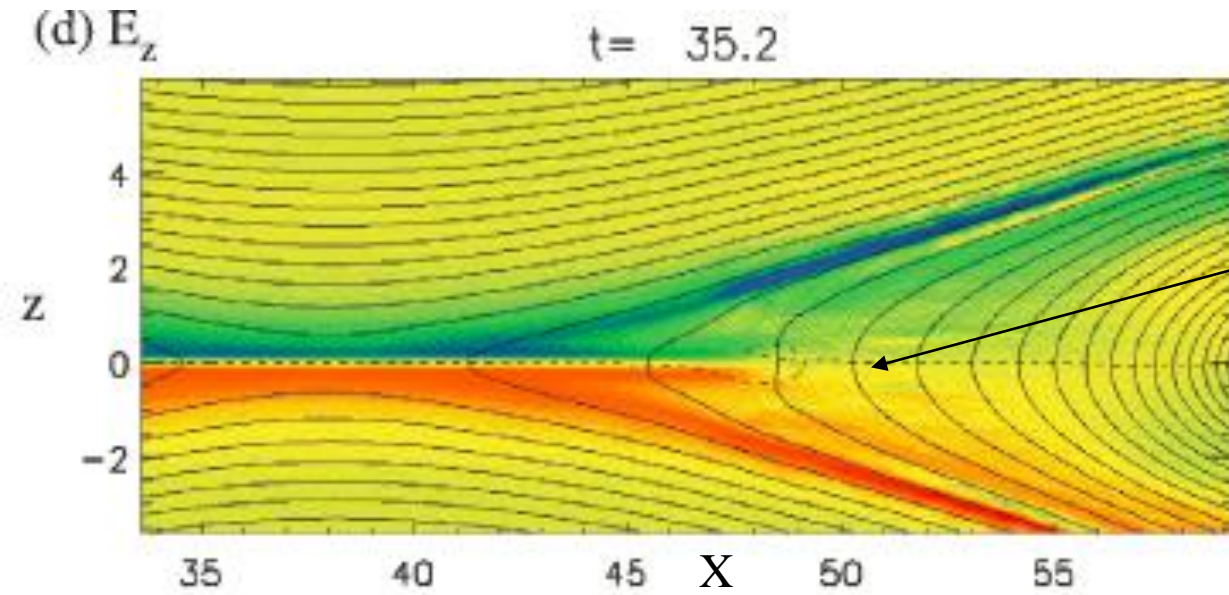
[Zenitani et al., 2013]



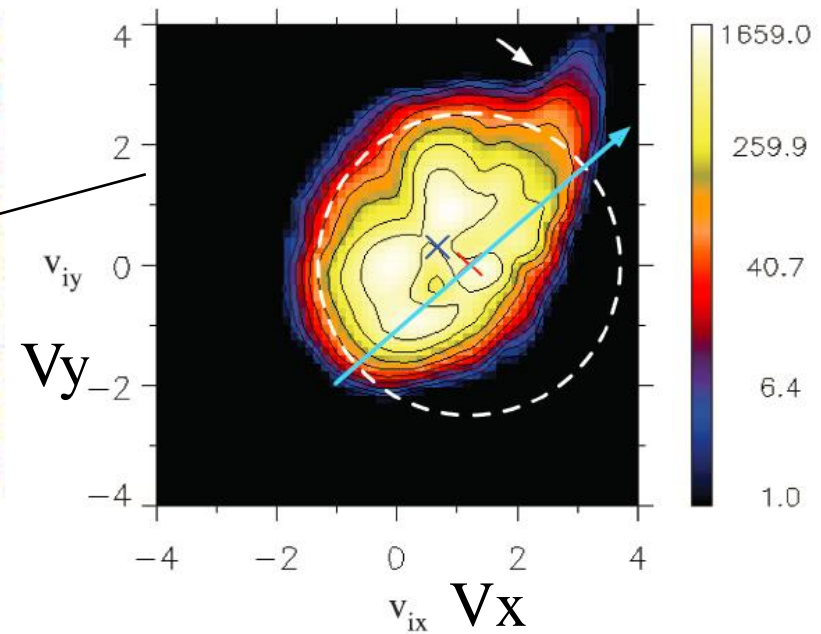
- Counter-streaming V_z at $V_y < 0$
- Accelerated ions at $V_y > 0$

Geotail observation
[Nagai et al., 2015]

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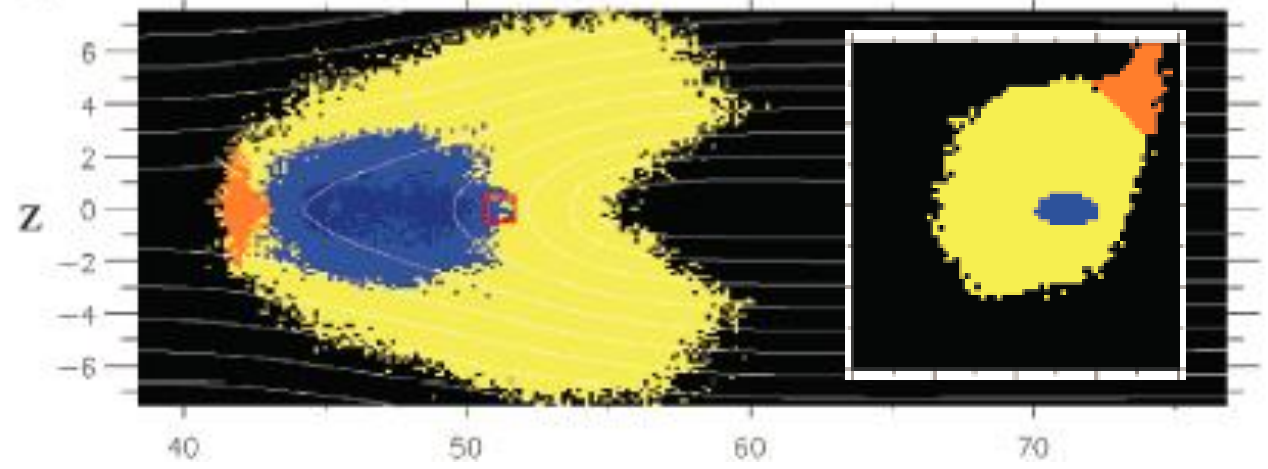


(a) Ion velocity distribution

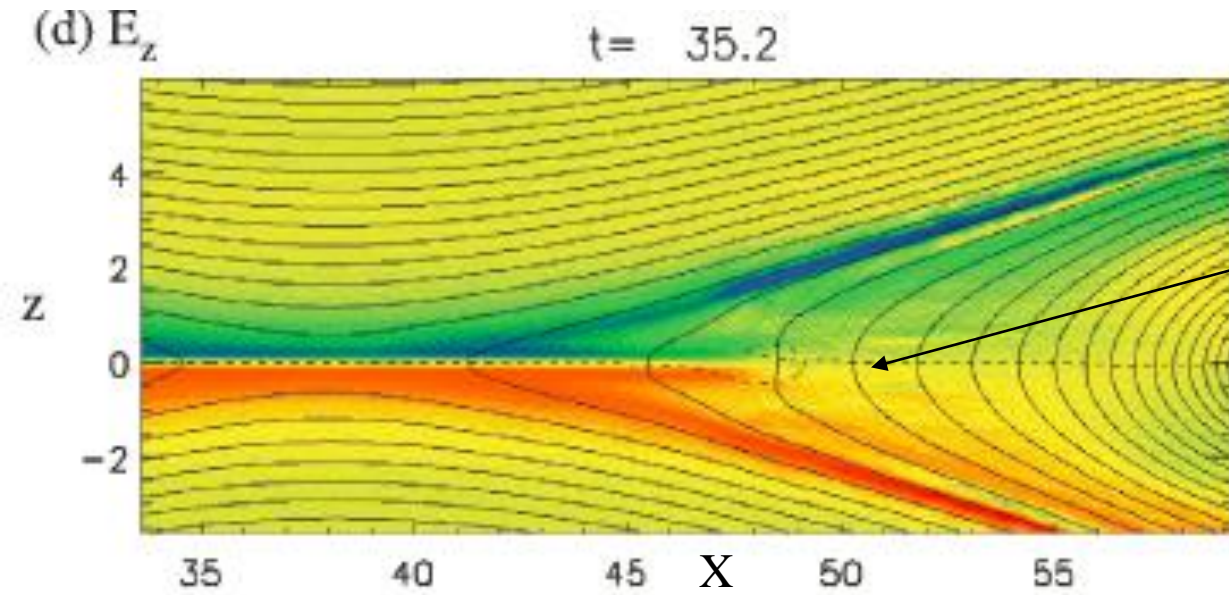


[Zenitani et al., 2013]

- **Mixing of ions from the X-line and from downstream regions with the speiser-like motion**



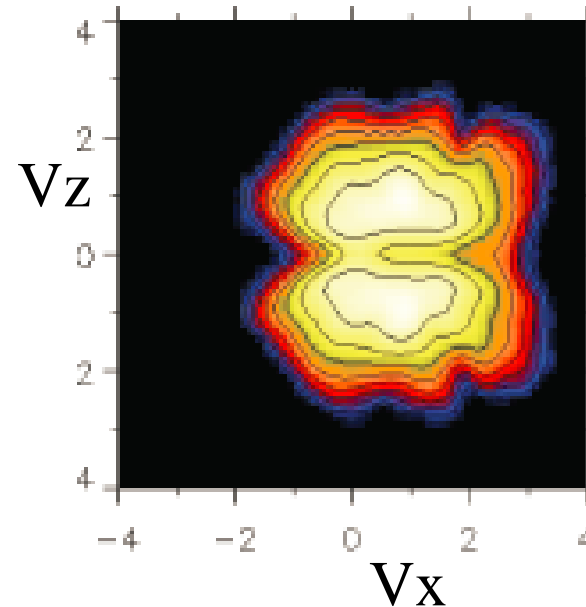
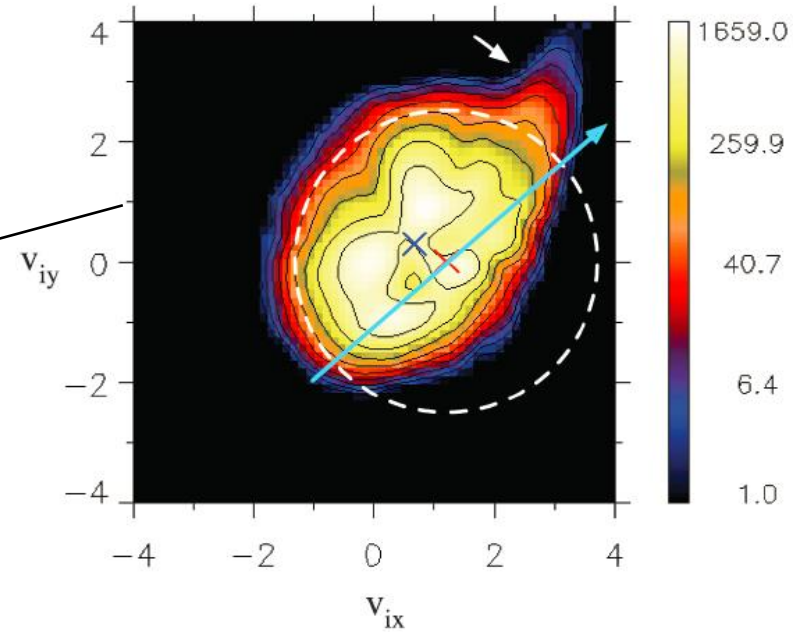
Introduction



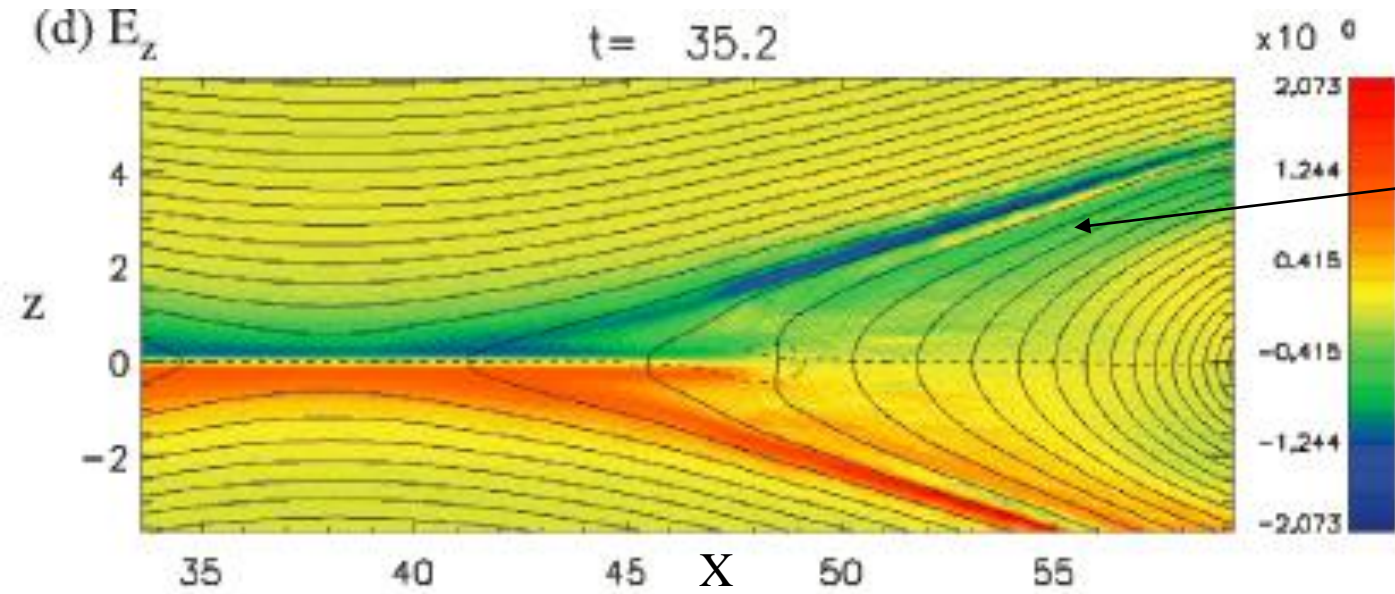
[Zenitani et al., 2013]

- Mixing of ions from the X-line and from downstream regions with the speiser-like motion
- **Acceleration by E_x** [e.g., Aunai et al., 2011]

(a) Ion velocity distribution

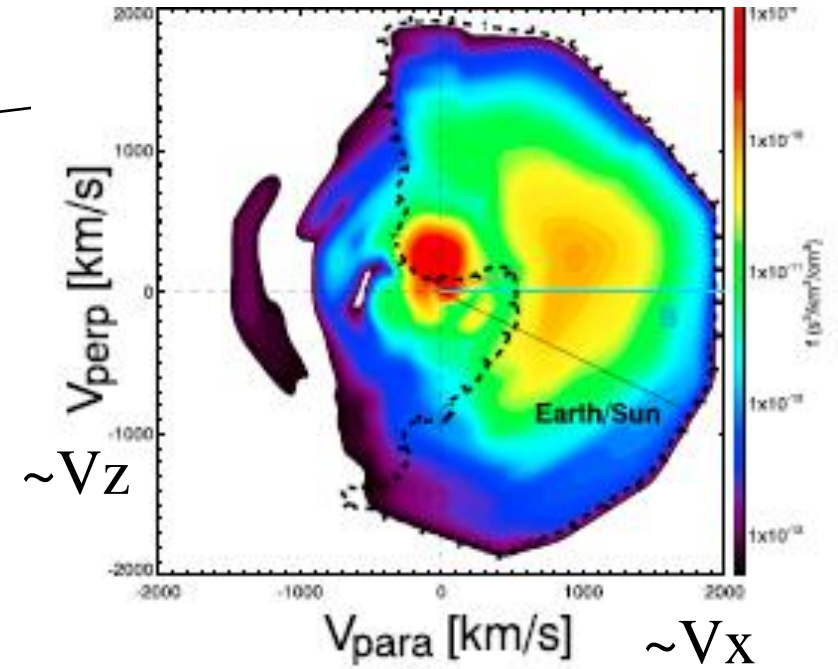


Introduction



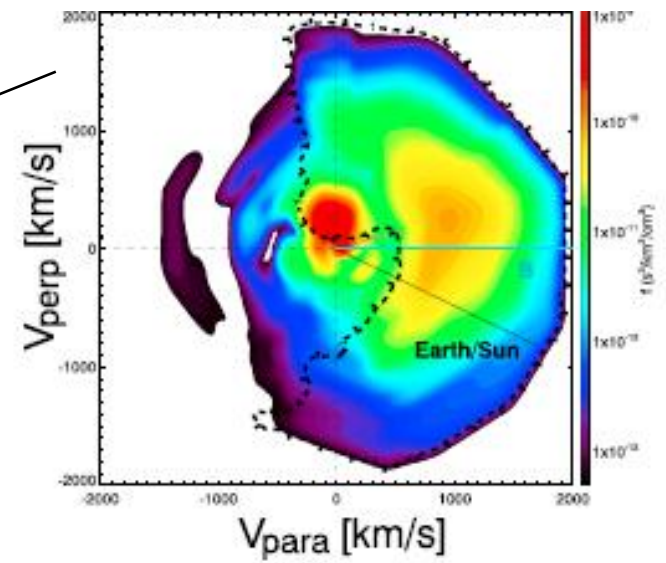
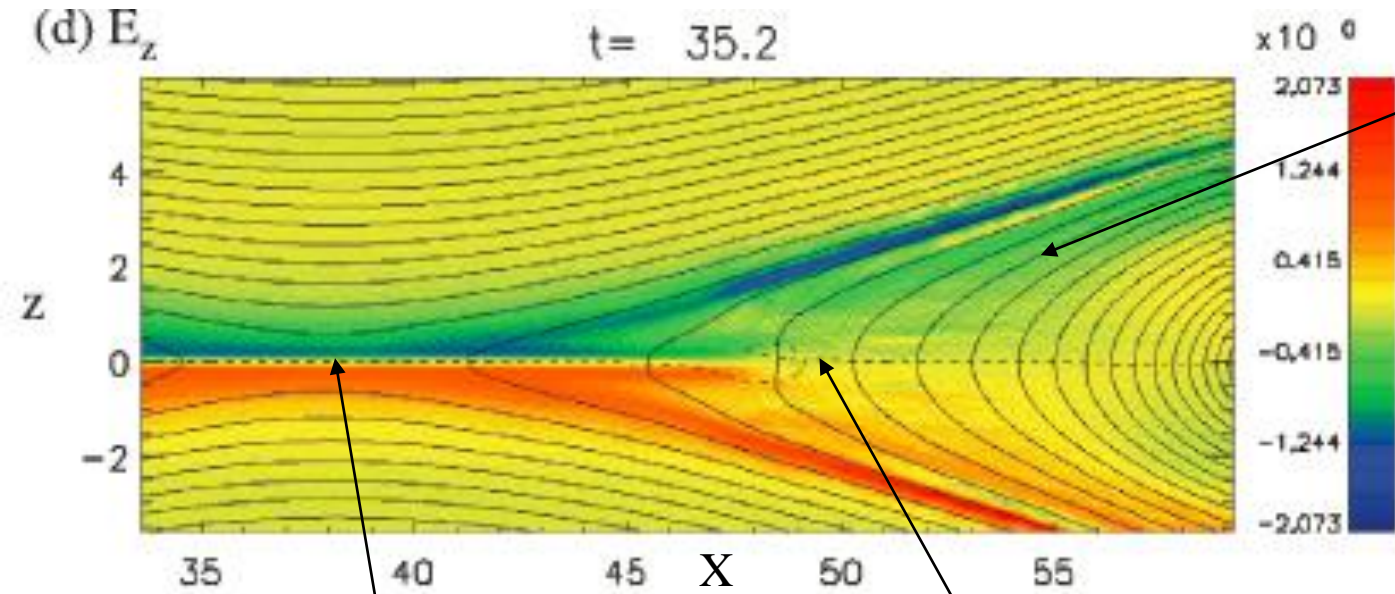
[Zenitani et al., 2013]

Downstream separatrix region, field-aligned counter-streaming populations

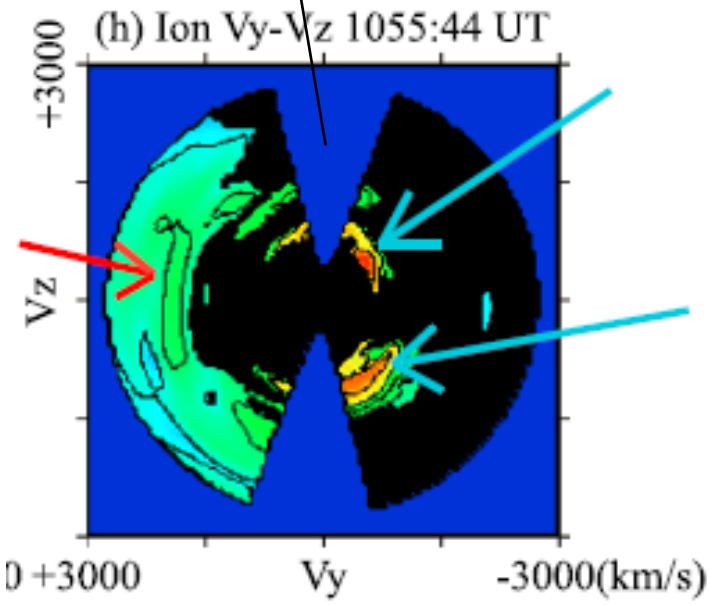


Themis observation
[Hietala et al., 2017]

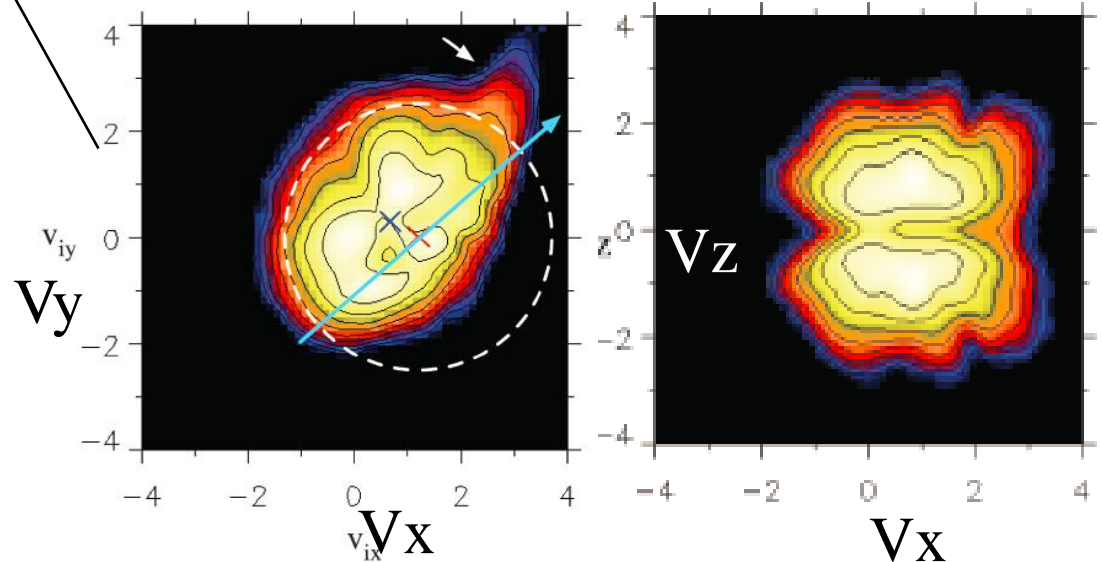
Introduction



[Zenitani et al., 2013]

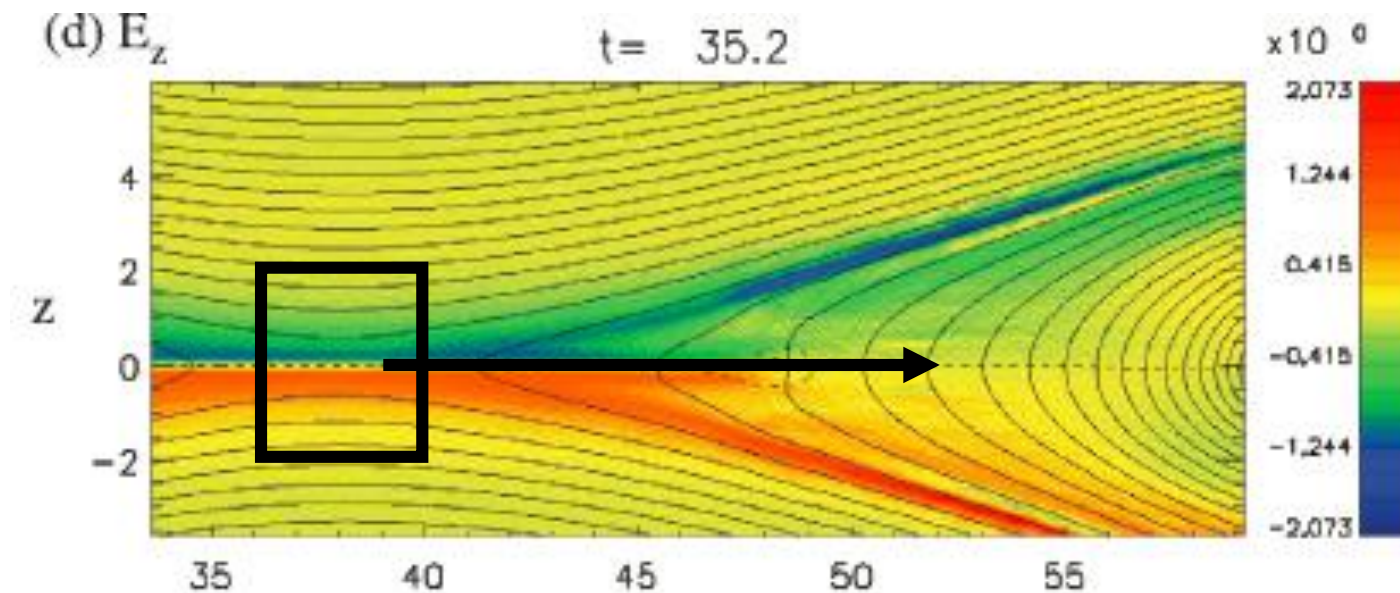


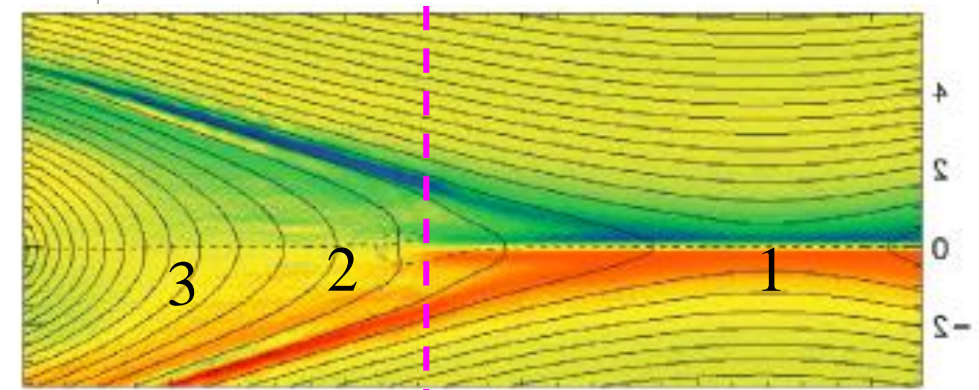
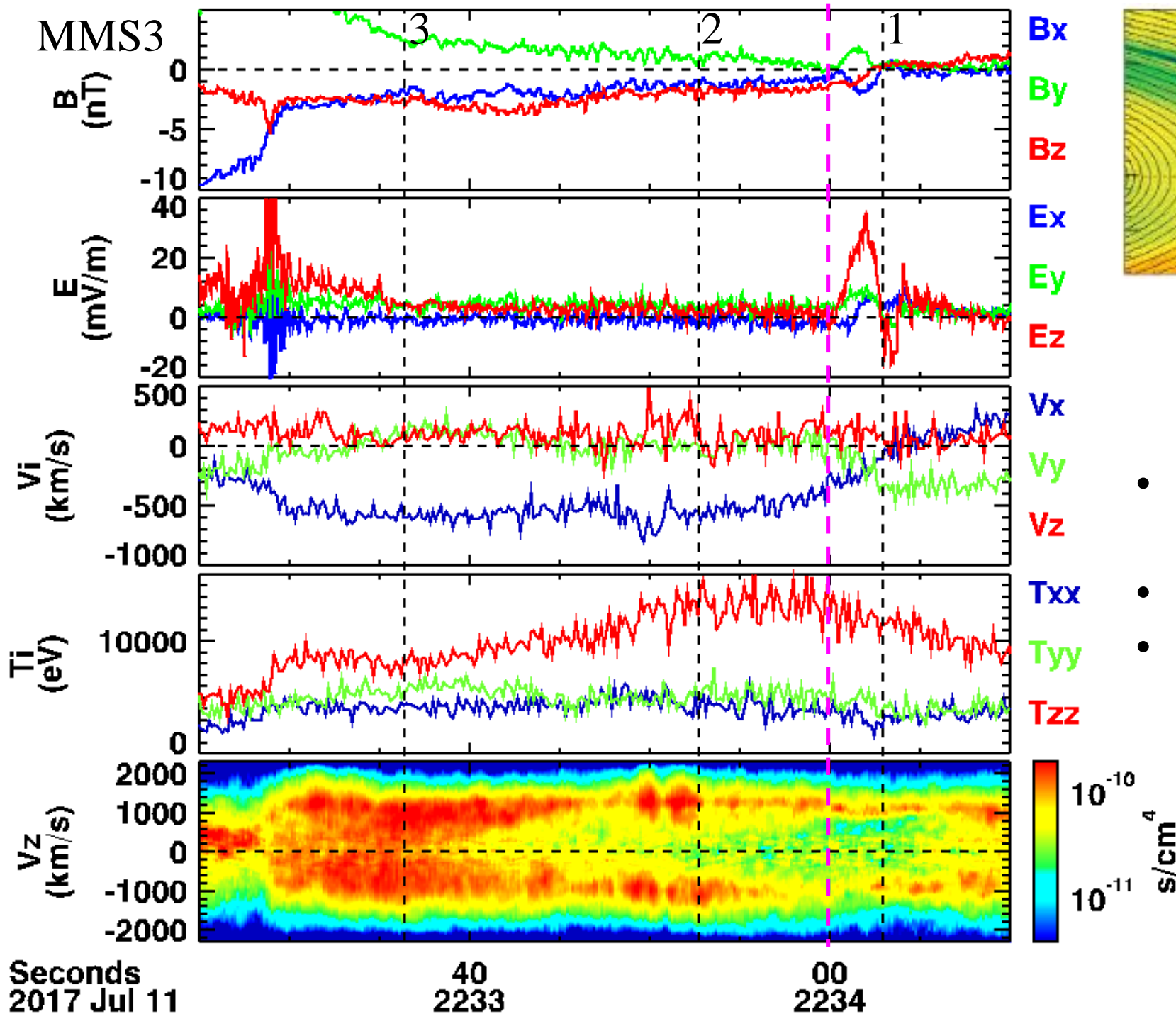
(a) Ion velocity distribution



Questions:

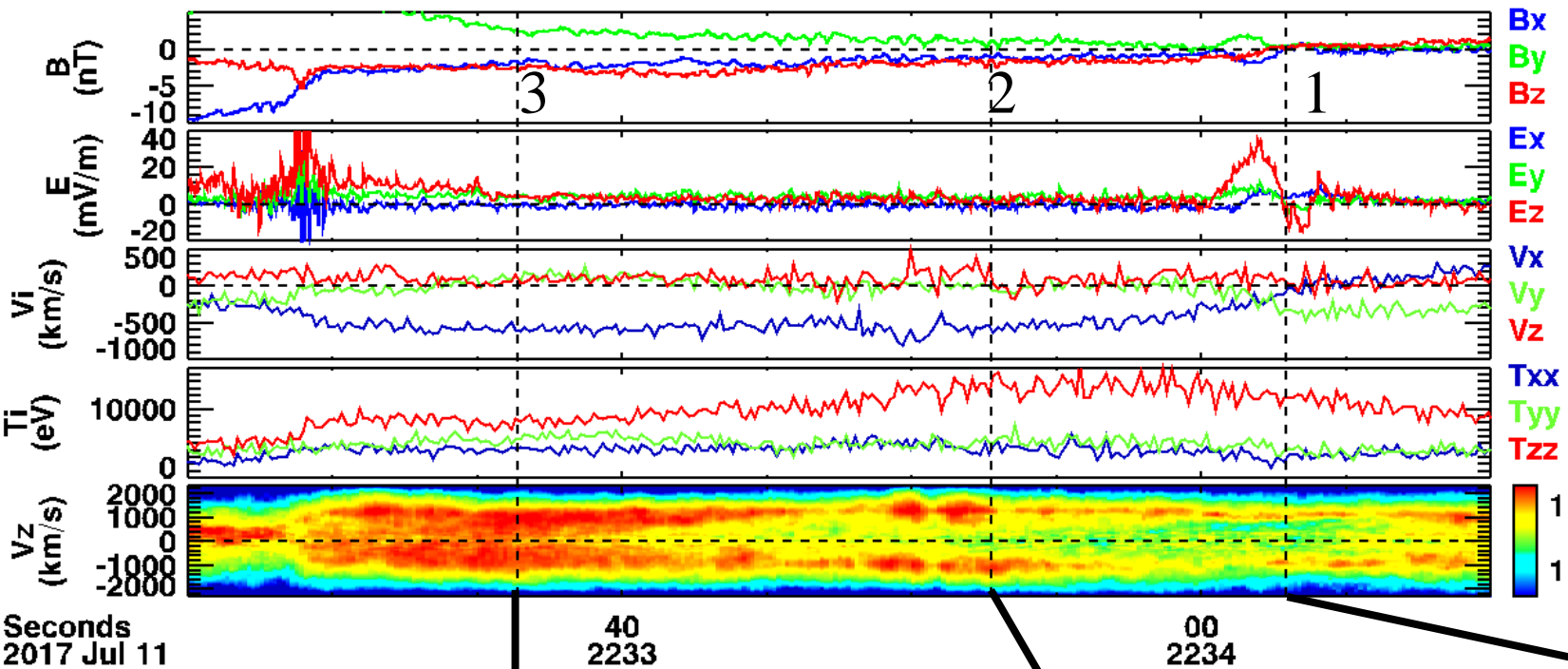
- Detailed ion distribution structures in different EDR events and the outflow jet formation [Giles et al., 2019, in prep]
- Thermalization/heating across reconnection regions
- 3D effects on ion distributions in the diffusion region



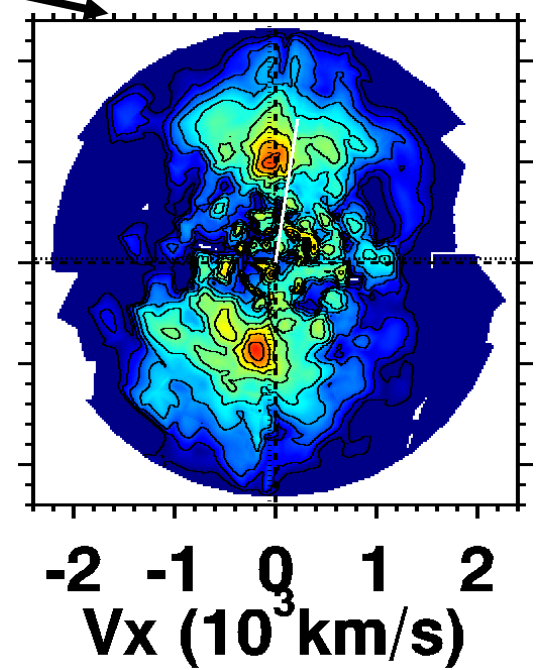
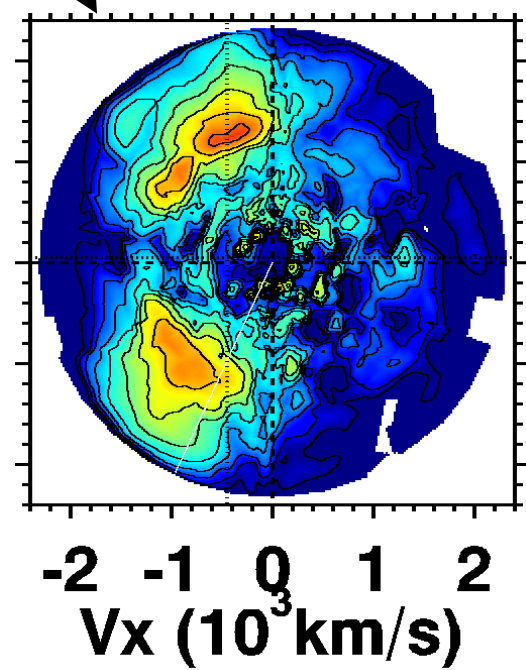
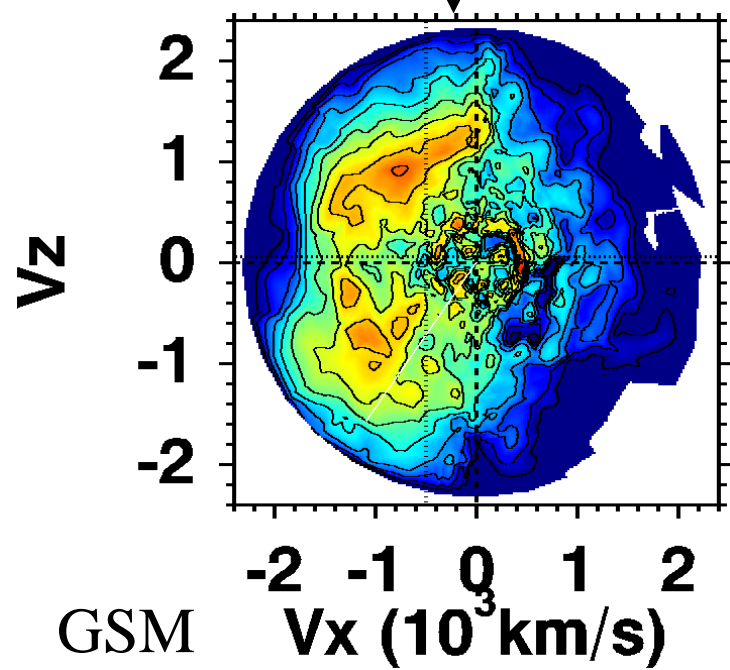


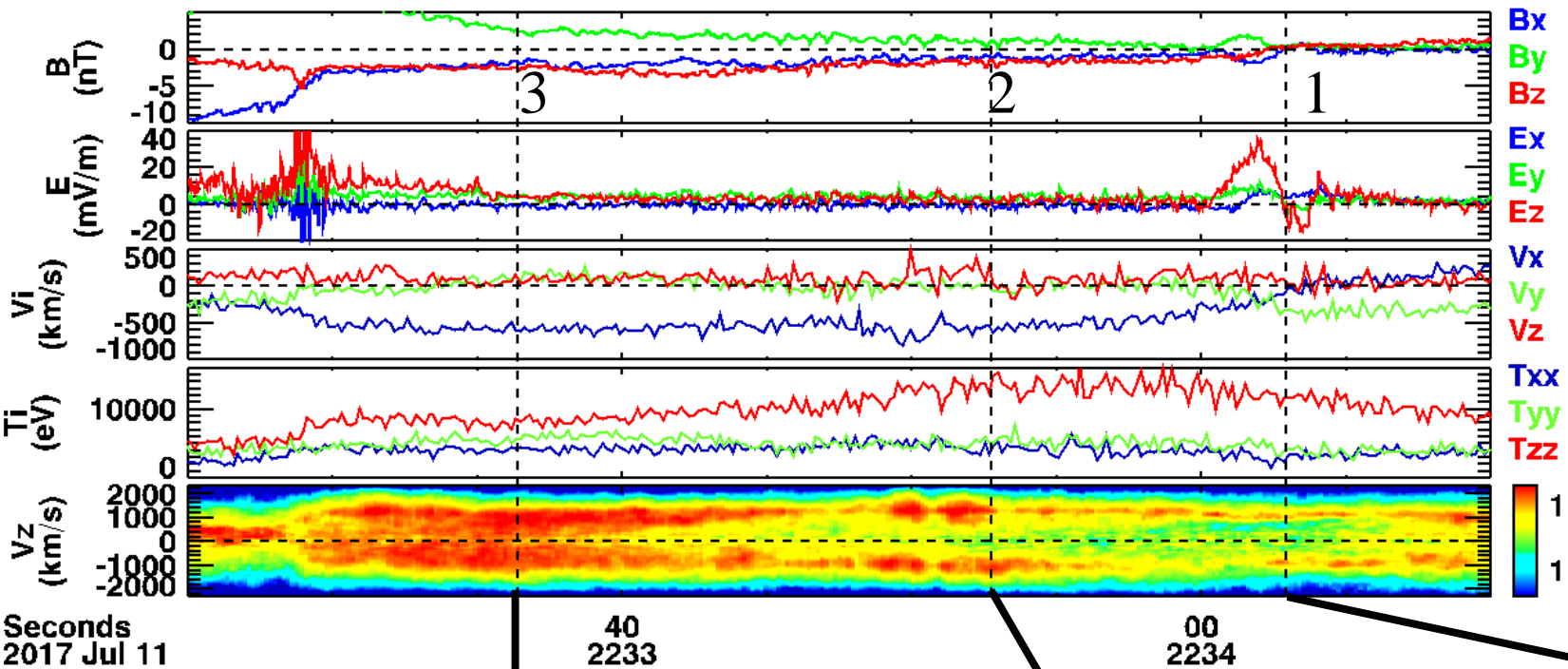
- T_{izz} is the dominant component due to counter-streaming V_z
- T_{izz} increases \rightarrow decreases
- T_{ixx}, T_{iyy} slightly increase

EDR encounter
 [Torbert et al., 2018; Giles et al., 2019, in prep]



- Tizz increase: increased counter-streaming separations (potential drop)
- Tizz decrease: mixing of ions from different locations with different amounts of acceleration -- **thermalization**



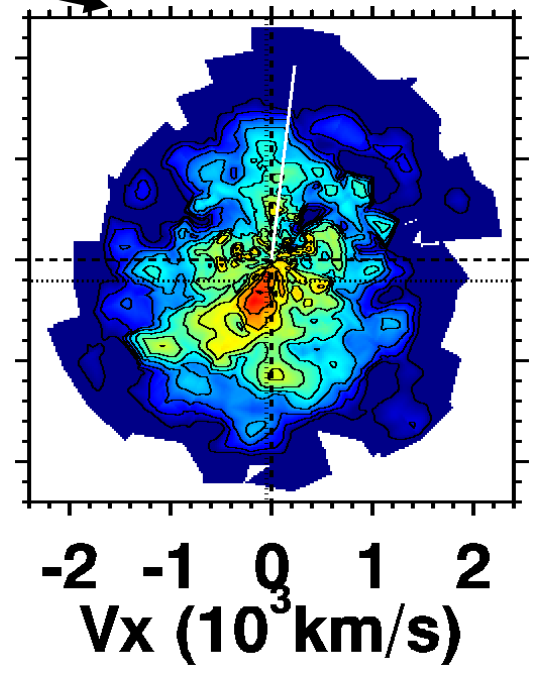
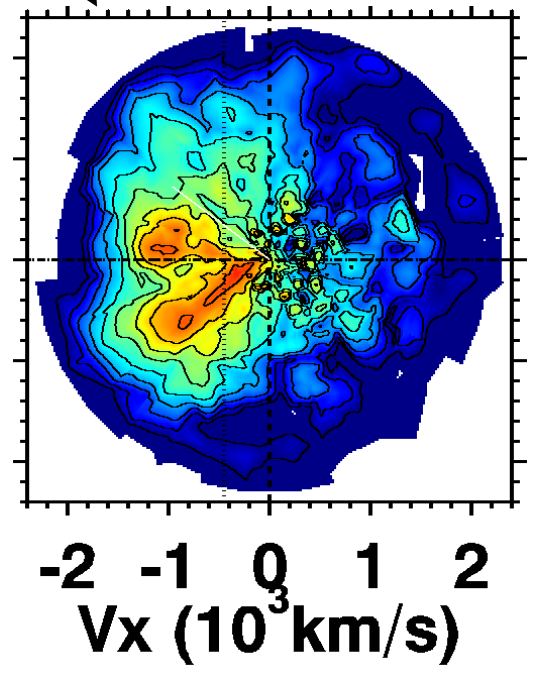
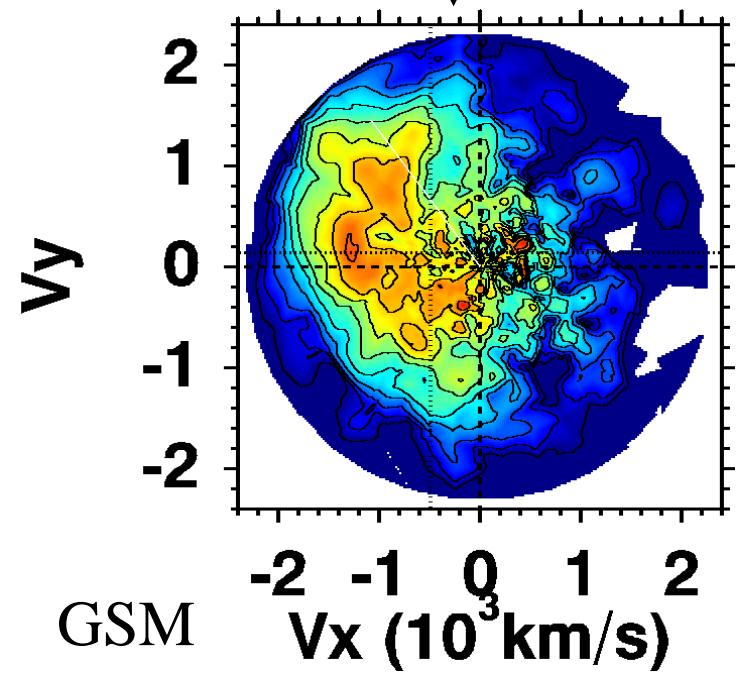


T_{ixx}, T_{iyy} increase: mixed ions with different amounts of acceleration and gyro-turning during the Speiser motion

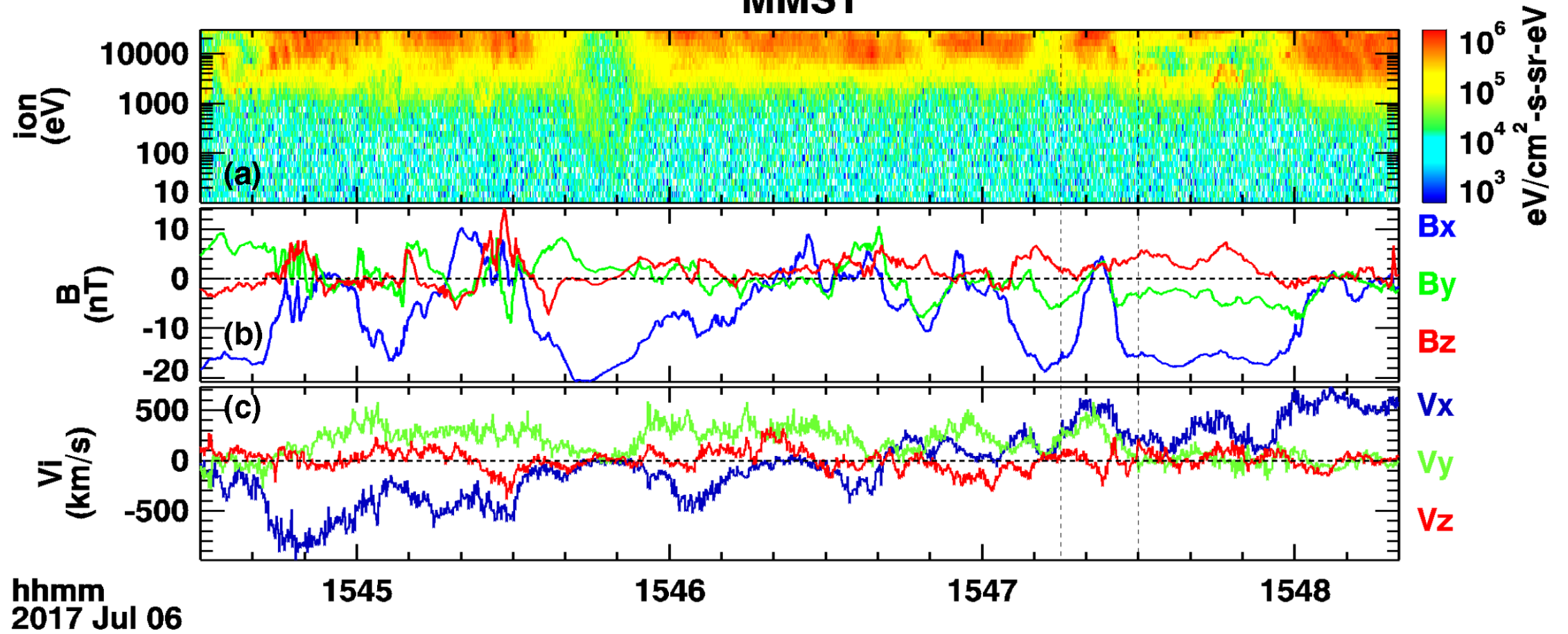
Seconds
 2017 Jul 11

40
 2233

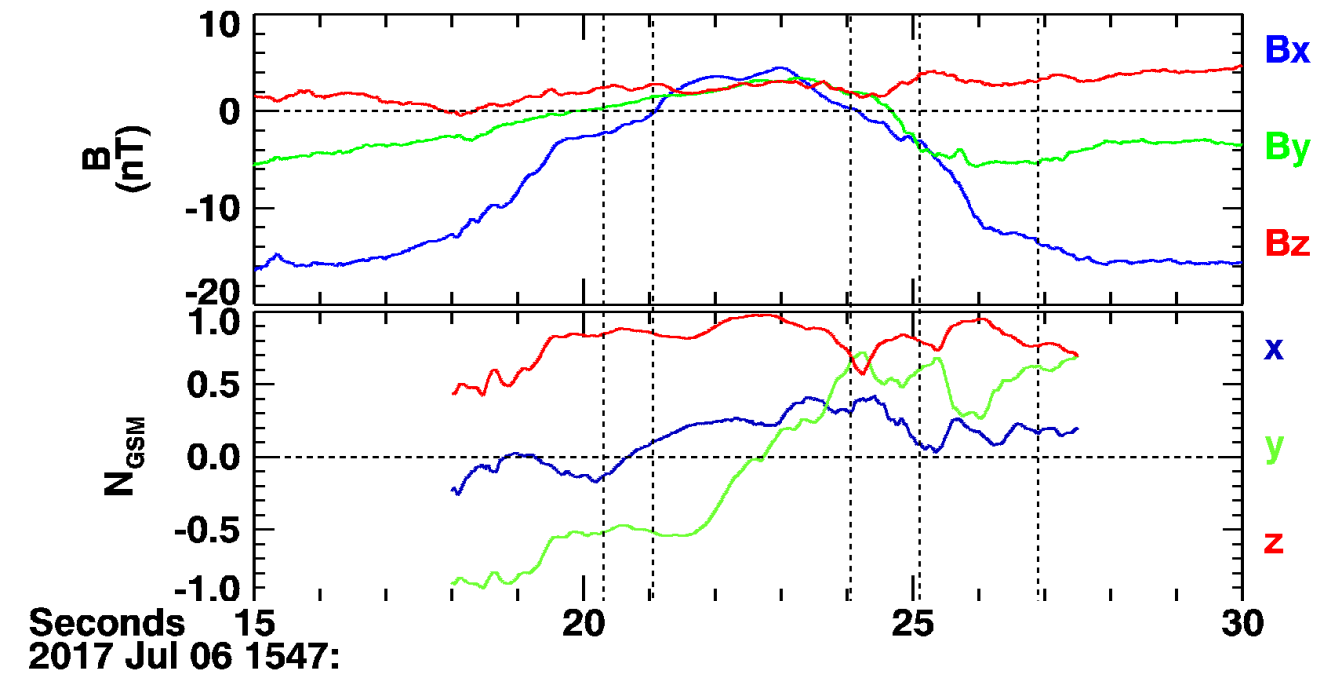
00
 2234



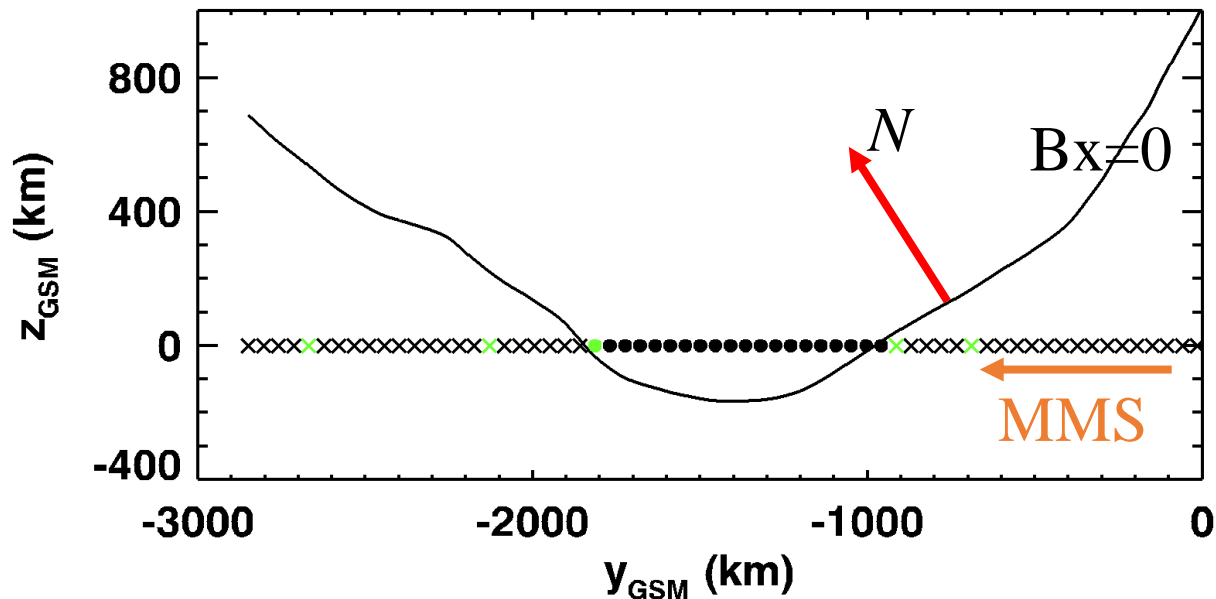
MMS1

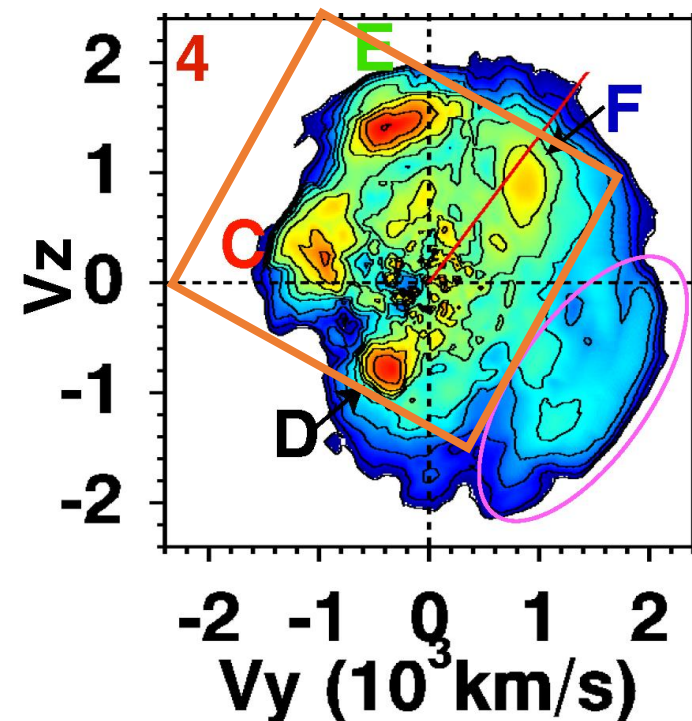
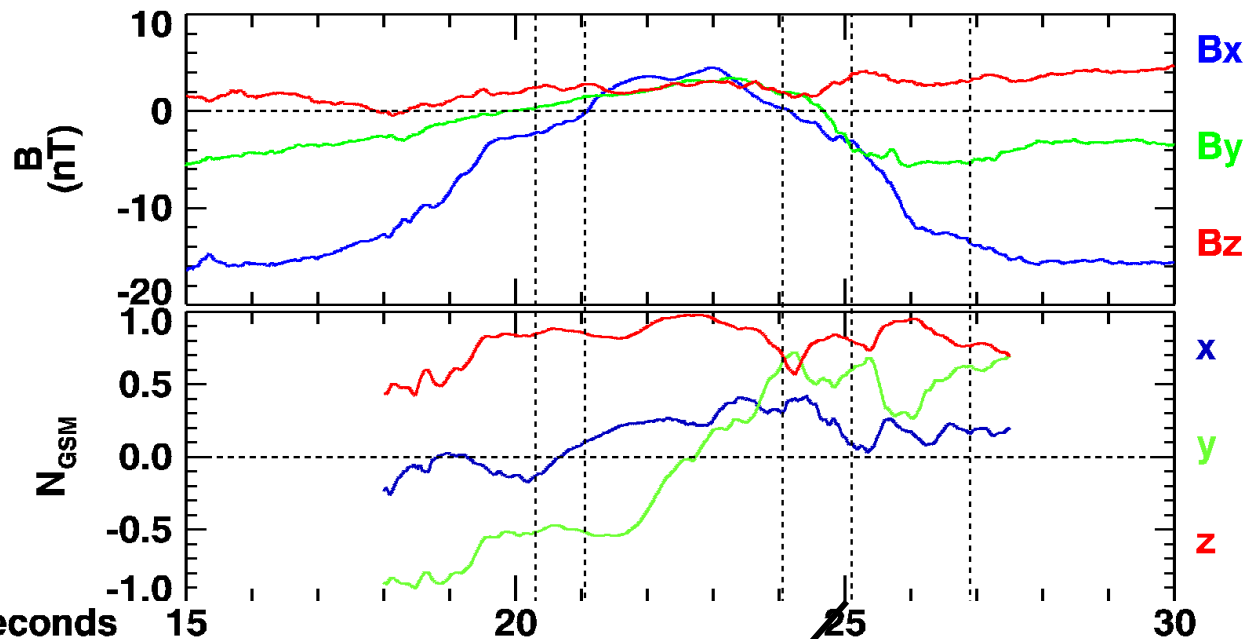


Possible ion diffusion region in a not-so-quiet current sheet: V_{ix} reversal

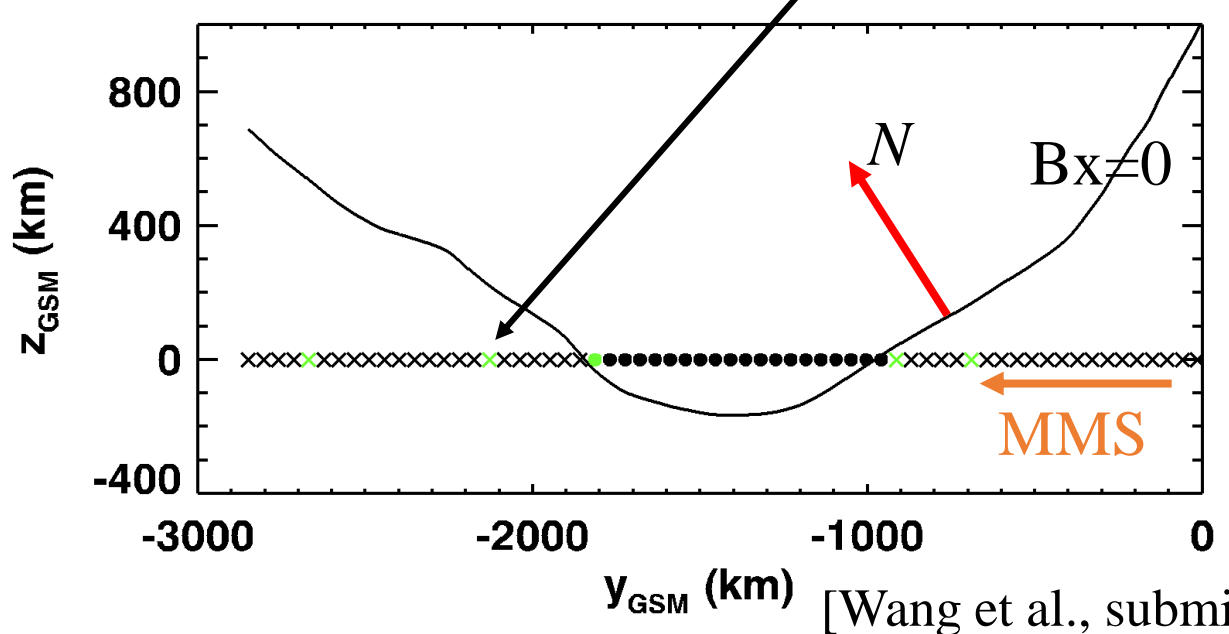


Continuous variations of the current sheet orientation – a corrugated (flapping) current sheet

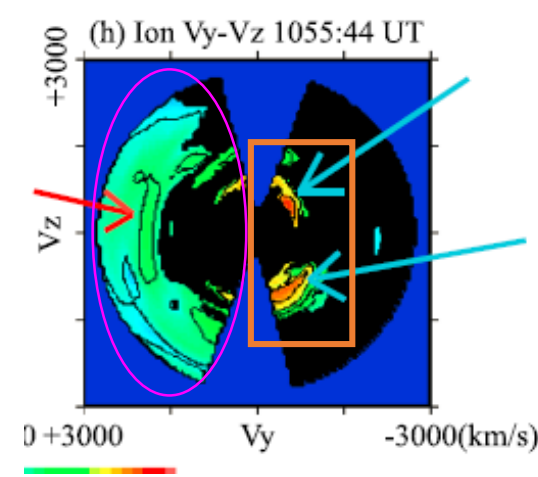




Seconds 15
2017 Jul 06 1547:
20
25
30



- Acceleration by E_M and E_N is observed
- Enhanced mixing of ions from different entry locations



Conclusions

- The high T_i in the central diffusion region is set up by the effective temperature of accelerated ions, and the thermalization is achieved by mixing of ions.
- Three-dimensional effects on ions in the diffusion region: the corrugated current sheet enhances ion mixing.